COSEWIC
Assessment and Status Report

on the

Hooded Warbler
Setophaga citrina

in Canada

NOT AT RISK
2012

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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COSEWIC
Assessment Summary

Assessment Summary – May 2012

Common name
Hooded Warbler

Scientific name
Setophaga citrina

Status
Not at Risk

Reason for designation
In Canada, the range and abundance of this forest-nesting species have increased substantially since the species was last assessed. The species has also experienced a significant long-term increase in abundance in the core of its range in the United States, so there is an outside source for rescue. However, habitat degradation at breeding sites and habitat loss and degradation at migration stopover sites and on the wintering grounds are potential threats.

Occurrence
Ontario

Status history
Designated Threatened in April 1994. Status re-examined and confirmed in November 2000. Status re-examined and designated Not at Risk in May 2012.

COSEWIC
Executive Summary

Hooded Warbler
Setophaga citrina

Wildlife Species Description and Significance

This small yellow songbird is readily identified by its distinctive plumage and vocalizations. Adult males have a characteristic black hood but this feature is reduced or lacking in adult females.

Distribution

The Hooded Warbler is a long-distance migrant that breeds in eastern North America and winters in Mexico, Central America and the Caribbean. The breeding range of this species has been expanding northwards for at least 40 years. The Canadian breeding distribution is restricted to southern Ontario, where it is considered to be a rare or locally uncommon breeder.

Habitat

The Hooded Warbler typically nests in shrubs associated with small canopy-gaps within large tracts (>100 ha) of mature deciduous or mixed forests. High densities can occur following selective logging, provided many mature trees remain. On the wintering grounds, there is strong sexual segregation by habitat with males preferring closed canopy forests and females preferring more open shrubby habitats.

Biology

This insect-eating passerine begins breeding when it is 1 year old. Hooded Warblers typically lay 3 or 4 eggs in cup-shaped nests, 1 m from the ground, that are frequently parasitized by Brown-headed Cowbirds. Nest predation rates are high (e.g., in Ontario 30-50% of nests are depredated). Even so, this species often succeeds in raising two broods to fledging in a single breeding season (early May through September in Ontario). Hooded Warblers rarely return to breed at their natal site, whereas adults show relatively strong fidelity to breeding and wintering sites. The expected life span is short, and the average age of breeding adults is about 2-3 years.

Population Sizes and Trends

Data from all sources show a consistent pattern of strong increases in the abundance and distribution of the Hooded Warbler population in Canada. The Canadian population is currently estimated to be between 1000 and 2000 breeding birds (much less than 1% of the global population). The Ontario Breeding Bird Atlas (OBBA) showed a strong population increase, from 21 atlas squares (10 km^2 survey blocks) with breeding evidence during 1981-85, to 81 squares during 2001-05, although with relatively greater search effort in the second atlas.

Directed searches at known and potential breeding locations in southern Ontario in 1997, 1998, 2002, and 2007 also documented ongoing increases in population size, number of occupied sites, and breeding distribution. The 1997 survey found 88 territorial males while the 2007 survey recorded at least 436 at 89 sites. These surveys covered most but not all areas with known or potentially occupied habitat in southern Ontario.

Threats and Limiting Factors

Given the observed increase in the Hooded Warbler population in Canada, habitat availability does not appear to be a limiting factor at present. Climate change appears to be an important factor in the observed range expansion. Some studies in Ontario have found low productivity and suggested that some areas may be acting as ecological sinks. However, there is also evidence that the Hooded Warbler population is very dynamic, and is characterized by high levels of immigration and emigration in response to habitat quality. Provided that there is an ongoing supply of suitable habitat, then it is likely that the Hooded Warbler population will continue to be stable, or increasing. Loss and degradation of habitat at migration stopover sites and on the wintering grounds have been identified as potential threats, but the magnitude of these threats is unknown.

Protection, Status, and Ranks

The Hooded Warbler is protected under the *Migratory Birds Convention Act* in Canada and the United States. It was assessed by COSEWIC in 1993 and again in 2000 and then listed as Threatened under the federal *Species at Risk Act* when the Act came into force in 2003. It is also listed as Special Concern under Ontario's *Endangered Species Act, 2007*. This species is considered globally secure by BirdLife International (Least Concern) and NatureServe (G5).

The current draft of the proposed federal Recovery Strategy identifies 56 sites in Ontario with critical habitat for this species, with a total area of about 9000 ha. None of the proposed critical habitat is on federal lands. Over half of the sites are on publicly owned lands, consisting mostly of managed forests that are not formally protected.

TECHNICAL SUMMARY

Setophaga citrina
Hooded Warbler — Paruline à capuchon
Range of occurrence in Canada: Ontario

Demographic Information

Generation time (usually average age of parents in the population)	2-3 yrs
Is there an observed continuing decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within 5 years. *Canadian population appears to be increasing.*	n/a
Observed percent increase in total number of mature individuals over the last 10 years. *Count of territorial males in Ontario increased from 88+ in 1997 to 436 in 2007. Ontario Breeding Bird Atlas data indicate >400% increase in probability of observation over 20-year interval between 1981-85 and 2001-05. After controlling for increased search effort, actual increase over last 10 years is >200%.*	>200%
Projected percent increase in total number of mature individuals over the next 10 years. *Long-term range expansion and population increase likely to continue.*	Unknown, but likely to be an increase
Estimated percent increase in total number of mature individuals over any 10 year period, over a time period including both the past and the future. *Ongoing range expansion.*	Unknown, but likely to be an increase
Are the causes of the decline clearly reversible and understood and ceased? *Factors driving the population increase and range expansion are not known.*	n/a
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence *Convex range envelope polygon encompassing all occurrences with confirmed or probable breeding evidence reported during the 2001-05 Ontario Breeding Bird Atlas project.*	ca. 50,000 km²
Index of area of occupancy (IAO) *Extrapolation from known breeding occurrences during 2001-10 period including the 2001-05 breeding bird atlas (178, 2x2km² cells with breeding evidence) and 2007 survey data (37 additional cells with breeding evidence).*	>1000 km² but <2000 km²
Is the total population severely fragmented?	No
Number of locations* *Based on the 89 sites (land ownership parcels) with breeding evidence reported during the 2007 survey.*	Unknown, but much greater than threshold level of 10 locations
Is there an observed continuing decline in extent of occurrence?	No, increasing
Is there an observed continuing decline in index of area of occupancy?	No, increasing
Is there an observed continuing decline in number of populations? *All sites presumably part of a single population.*	n/a
Is there an observed continuing decline in number of locations*?	No

* See Definitions and Abbreviations on COSEWIC website and IUCN 2010 for more information on this term.

Is there an observed continuing decline in area, extent and/or quality of habitat? *Loss of forest cover in western Carolinian Region offset by increases in eastern Carolinian Region. Expansion into areas of the Lake Simcoe-Rideau Region with higher forest cover.*	No
Are there extreme fluctuations in number of populations?	n/a
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Canadian breeding population (all in southern Ontario) is estimated to be in range of 1000-2000 mature individuals as of 2011 based on extrapolation from the population count of 436 territorial males in 2007, the extent of potentially occupied habitat not included in the 2007 survey, and the long-term increasing trend.	
Total	1000-2000

Quantitative Analysis

Probability of extinction in the wild. *Not available.*	n/a

Threats (actual or imminent, to populations or habitats)

Population increase suggests that there are no immediate widespread threats. Degradation of habitat at breeding sites in southern Ontario and habitat loss and degradation at migration stopover sites and on the wintering grounds are identified as potential threats.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? *Significant range-wide population increase and breeding range is expanding northwards. Significant increasing short- and long-term population trends in US states adjacent to Ontario breeding range.*	
Is immigration known or possible? *Large breeding population in northern US adjacent to Canadian population. Dispersal over distances of 20 km (within Ontario) has been documented and longer-distance dispersal is suspected.*	Yes
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada? *Habitat in southern Ontario is not saturated.*	Yes
Is rescue from outside populations likely?	Yes

Current Status

COSEWIC: Threatened (1993, 2000), Not at Risk (May, 2012)

Status and Reasons for Designation

Status: Not at Risk	**Alpha-numeric code:** None
Reasons for designation: In Canada, the range and abundance of this forest-nesting species has increased substantially since the species was last assessed. The species has also experienced a significant long-term increase in abundance in the core of its range in the United States, so there is an outside source for rescue. However, habitat degradation at breeding sites and habitat loss and degradation at migration stopover sites and on the wintering grounds are potential threats.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Does not meet criterion. Population has been increasing over the last three generations.
Criterion B (Small Distribution Range and Decline or Fluctuation): Does not meet criterion. Extent of Occurrence is greater than 20,000 km^2. IAO is less than 2000 km^2, but population does not meet subcriteria.
Criterion C (Small and Declining Number of Mature Individuals): Does not meet criterion. Population is less than 2500 mature individuals, but no evidence of a continuing decline.
Criterion D (Very Small or Restricted Total Population): Does not meet criterion. Population is greater than 1000 individuals, IAO is greater than 20 km^2 and there are more than 5 locations.
Criterion E (Quantitative Analysis): Not available.

PREFACE

The Hooded Warbler population in Canada has increased by over 200% and substantially expanded its extent of occurrence since it was last assessed by COSEWIC in 2000. There was a significant (>400%) increase in the probability of detection between the 1981-85 and 2001-05 Ontario Breeding Bird Atlases. Directed searches at known and potential breeding locations in southern Ontario in 1997, 1998, 2002, and 2007 documented ongoing increases in population size, number of occupied sites, and breeding distribution. This species has also experienced a significant long-term population increase and northward expansion in its core range in the United States. Based on these population increases, the status of this species in Ontario under the *Endangered Species Act, 2007* was downgraded from Threatened to Special Concern in 2009.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2012)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

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Hooded Warbler

Setophaga citrina

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2012

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Table 2. Population counts and estimates for the Hooded Warbler in Canada. 24

WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific Name: *Setophaga citrina* (Boddaert 1783)

English Name: Hooded Warbler

French Name: Paruline à capuchon

Class: *Aves*

Order: *Passeriformes*

Family: *Parulidae*

Genus: *Setophaga*

Species: *Setophaga citrina*

Classification follows the American Ornithologist Union (AOU 1998, 2011). No geographic variation or subspecies are recognized (AOU 1998; Chiver *et al.* 2011).

This member of the large New World wood-warbler (Parulidae) family was formerly classified in the genus *Wilsonia,* along with Wilson's Warbler (*Cardellina pusilla*) and Canada Warbler (*C. canadensis*). Recent changes (AOU 2011) have now placed Hooded Warbler within the genus formerly known as *Dendroica*; now named *Setophaga*. There are now 34 warbler species within this genus (AOU 2011).

Morphological Description

The Hooded Warbler is a small songbird (body length: 13 cm, body mass: 11 g) with a striking plumage and a distinctive vocal repertoire. Both sexes have olive-green upperparts, a bright yellow underside, and characteristic white tailspots that are visible when the tail is fanned out. Adult males have a well-defined black hood, contrasting with bright yellow cheeks and forehead. Adult females have a variable amount of black on the head, ranging from none (typically during the first breeding season only) to almost a full black hood in some individuals. Juvenile birds (recent fledglings) of both sexes have a dull yellowish plumage with no head markings. On close examination, retained juvenile flight feathers can be used to reliably distinguish most young birds (of either sex) through to the end of their first breeding season (Pyle 1997; Chiver *et al.* 2011).

Population Spatial Structure and Variability

There is no evidence of population structuring within the Canadian or North American population of this species. The small Canadian population is contiguous with much larger breeding populations of the northern United States. Lake Erie does not pose a significant geographic barrier to this migratory species, although it may reduce immigration rates (Melles *et al.* 2011).

No biochemical or genetic studies are available.

Designatable Units

All Hooded Warblers breeding in Canada are within a single population and therefore only one designatable unit is considered in this report.

Special Significance

The habitat requirements of the Hooded Warbler in Canada overlap to varying degrees with those of the more than 30 Canadian species at risk associated with Carolinian woodlands in southern Ontario (Jalava *et al.* 2008). Forest birds of conservation concern breeding in close proximity to Hooded Warblers in Ontario include: Acadian Flycatcher, *Empidonax virescens,* Endangered; Cerulean Warbler, *Setophaga cerulea,* Endangered; and Louisiana Waterthrush, *Parkesia motacilla,* Special Concern.

No Aboriginal Traditional Knowledge is currently available for this species.

DISTRIBUTION

Global Range

The Hooded Warbler is a long-distance neotropical migrant that breeds in eastern North America, and winters in southern Mexico, Central America and parts of the Caribbean (Figure 1).

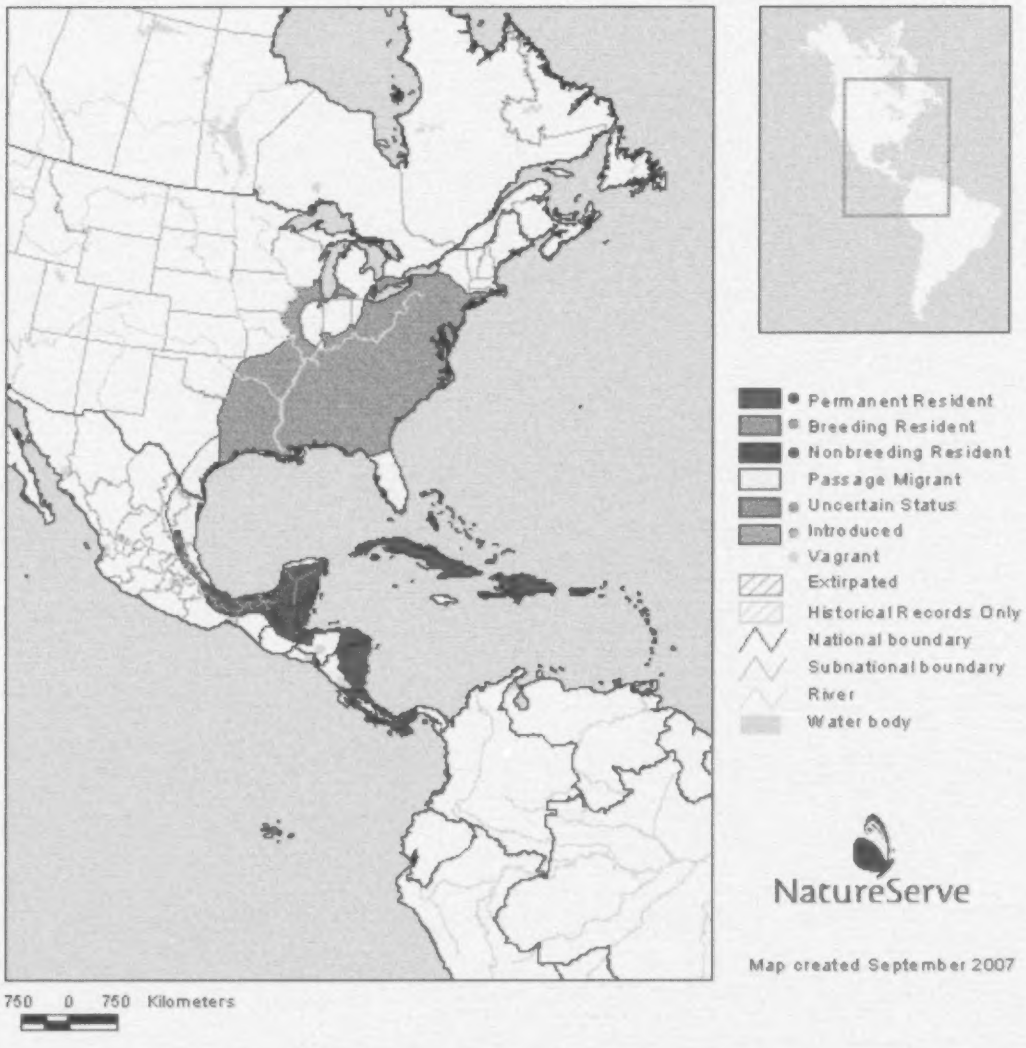

Figure 1. Breeding and non-breeding distribution of the Hooded Warbler (Ridgeley *et al.* 2007).

The breeding range of this species corresponds closely to the North American Eastern Deciduous Forest Biome, being widely distributed in forested landscapes east of the Great Plains. The northern breeding limit currently extends from Minnesota to Massachusetts, crossing through southern Ontario. Its breeding distribution at the northern periphery of the range is patchy.

During the mid- to late-20th century, the breeding range of the Hooded Warbler expanded. Data from the North American Breeding Bird Survey (BBS) indicate that the northern margin of the breeding distribution shifted 115 km north over a 26-year interval (Hitch and Leberg 2007). Breeding Bird Atlas (BBA) data from New York State document a northward range expansion of 25 km over a 20-year interval (Zuckerberg *et al.* 2009). The breeding range within Canada has also expanded over time (see Canadian Range and Population Trends sections).

The wintering range extends from Mexico south to Panama and east to the Caribbean, but within this range this species is most common in southeastern Mexico (especially Yucatan Peninsula), Belize, Guatemala, and Honduras (Chiver *et al.* 2011; NatureServe 2011). Changes in wintering distribution have not been documented.

During spring and fall migration, this species uses both the trans-gulf and circum-gulf migration paths to varying extents and is found in southern Florida and along the Gulf Coast. It appears that a greater proportion of the population uses the shorter Gulf of Mexico crossing in spring migration than in fall, and that adults are more likely than immature birds to cross the Gulf in the fall (Chiver *et al.* 2011).

The total global breeding range (extent of occurrence) is approximately 2,000,000 km^2, while the total global wintering range is much smaller at approximately 750,000 km^2 (derived from Ridgeley *et al.* 2007).

Canadian Range

The Hooded Warbler's Canadian breeding distribution is restricted to southern Ontario, where it is considered a rare to locally uncommon breeder (Godfrey 1986; James 1991; Badzinski 2007). The Ontario Breeding Bird Atlas (OBBA) mapping (
Figure 2) provides a good representation of the current Canadian range, and also illustrates the significant increase in the species' distribution in Ontario over the 20-year interval between the first (OBBA1, 1981-85) and second (OBBA2, 2001-05) atlases (Badzinski 2007; Blancher *et al.* 2007).

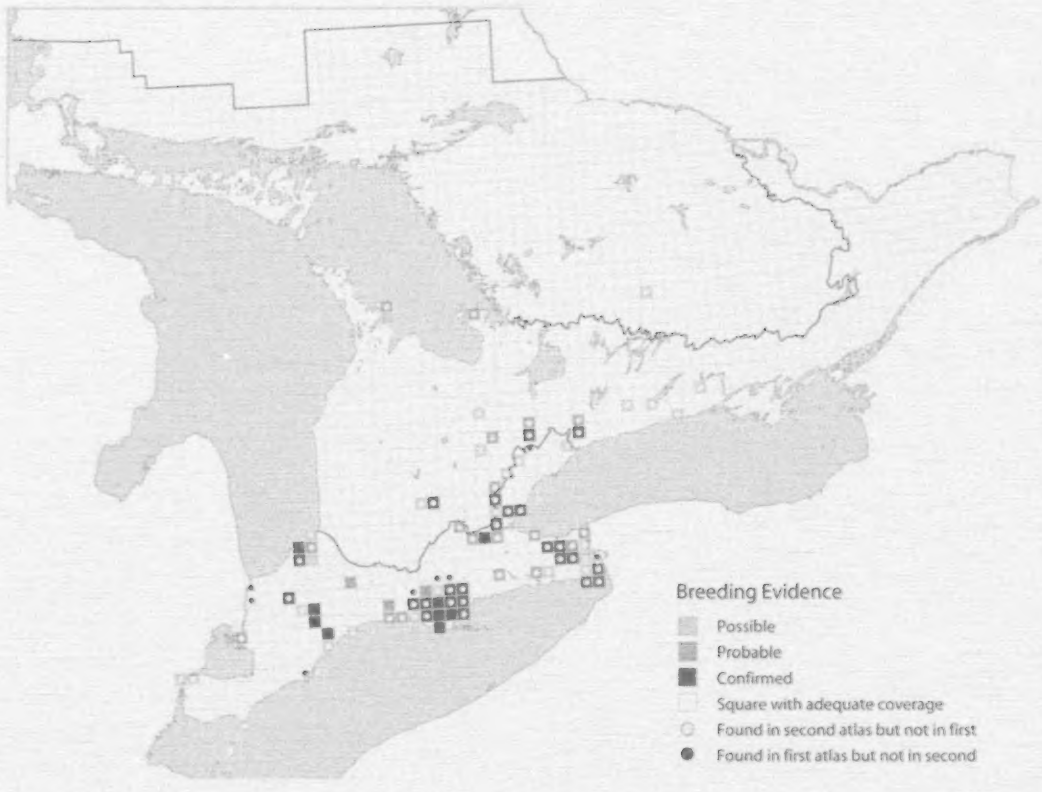

Figure 2. Hooded Warbler breeding evidence during Ontario Breeding Bird Atlases, 1981-1985 and 2001-2005 (based on Cadman *et al.* 2007). The grey lines delineate the boundaries of the Carolinian, Lake Simcoe-Rideau, and Southern Shield ecological regions (from south to north).

All confirmed and probable Canadian breeding records fall within the Mixedwood Plain Ecozone, with the majority concentrated in the Carolinian biogeographic region. Scattered records with possible breeding evidence (e.g., singing male observed in suitable habitat during the breeding season over a 1-6 day period) have been reported from the southern margin of the Boreal Shield Ecozone (Southern Shield region), including one possible breeding record during OBBA2 (
Figure 2).

The extent of occurrence (EO) of the Hooded Warbler in Canada, as delineated by the convex range envelope polygon described by all occurrences with probable or confirmed breeding evidence reported during OBBA2 (2001-05), is approximately 50,000 km^2 (or about 75,000 km^2 if records with possible breeding evidence are included). More recent breeding occurrences (2006-2010), including records from an extensive targeted survey in 2007 (see Sampling Effort and Methods), fall within the 2001-05 EO polygon. The 2001-05 EO is more than double the comparable figure calculated using OBBA1 data from 1981-85.

The index of area of occupancy (IAO) was calculated by assigning available geo-referenced breeding evidence data to standard 2 km x 2 km cells. During OBBA2, probable or confirmed breeding evidence was provided from 100 cells and possible breeding evidence was reported for an additional 78 cells, for a total of 712 km^2 cells with breeding evidence. During the 2007 Hooded Warbler survey, breeding evidence was reported in an additional 37 cells. Thus, the IAO of all known breeding occurrences during 2001-2010 is 860 km^2. The current IAO is estimated to be in the range of 1000-2000 km^2. These limits assume that breeding evidence was reported for 50-85% of all cells occupied between 2001 and 2010. This estimate seems reasonable given the amount of potentially occupied habitat that was not surveyed, the clumped breeding distribution of the species, and the overall intensity and distribution of the survey effort during this 10-year period. Given the reported average territory size of about 3 ha in Ontario (see Habitat Requirements), the biological area of occupancy over the past decade exceeds 25 km^2.

Changes in the Canadian Range and Breeding Status

The Hooded Warbler was first reported in Canada before 1860 at Hamilton, Ontario and it was considered "a rare migrant" in Ontario during the early 1900s (Baillie 1925). Breeding was first confirmed in 1949, when a nest was found at Springwater Forest, Elgin County (Gartshore 1988; Bodsworth 2004). Only five more nests were found over the following 36 years (Gartshore 1988). At the start of OBBA1 in 1981, the species was considered "a straggler that occasionally bred in Ontario" (Sutherland and Gartshore 1987). By the end of OBBA1, it was clear that Hooded Warbler was a rare but regular breeding species in Ontario and it was suggested that the species "probably always bred in southern Ontario in small numbers but generally escaped notice" (Sutherland and Gartshore 1987).

After 1985, the number and extent of known breeding occurrences in Ontario surged. Only in the past decade, with completion of OBBA2 and additional intensive surveys, has uncertainty as to whether the observed increase was real or due entirely to increased search effort and searcher efficiency (see Austen *et al.* 1994; James 2000) been resolved. See Population section for further details on recent changes in distribution and abundance.

The breeding status of the Hooded Warbler in Canada before 1949 remains uncertain, but given the northward range expansion in the global range, it seems likely that the breeding range of this species first expanded into Canada during the early 20th century. There is no substantive evidence to support the alternate view that this species likely occurred widely in the extensive forest habitat present before European settlement but subsequently declined or disappeared due to habitat loss in the 1800s, as suggested in previous status reports (Page and Cadman 1994; James 2000).

Search Effort

Search effort and efficiency has increased over time. See Sampling Methods and Effort section for details.

HABITAT

Habitat Requirements

Breeding Habitat

The Hooded Warbler is a forest-obligate species and breeds in mature forests in upland or bottomland situations (Chiver *et al.* 2011). Forest composition appears to vary regionally, with various studies reporting positive or negative associations with deciduous hardwood forests or with pine (Mitchell *et al.* 2001; Twedt *et al.* 2010; Chiver *et al.* 2011). In Ontario, Hooded Warblers are found primarily in mature upland forests, including deciduous and mixed forests and pine plantations (Gartshore 1988; Austen *et al.* 1994; Badzinski 2007; Walters and Nol 2011).

This species is considered a "gap specialist" as nest sites are consistently associated with canopy gaps with a high density of shrubs (Chiver *et al.* 2011; Walters and Nol 2011). Suitable canopy gaps can be created by natural tree-fall, timber harvesting using single-tree or group selective cutting methods, or thinning of mature pine plantations (Gartshore 1988; Whittam *et al.* 2002; Eng 2007; Chiver *et al.* 2011). In Ontario, Hooded Warblers consistently chose nest sites in areas within the forest with dense vegetation (often raspberry or blackberry brambles, *Rubus* spp.) within 1 m of the ground (Gartshore 1988; Bisson and Stutchbury 1998; Whittam *et al.* 2002; Eng 2007; Walters and Nol 2011; BSC unpub. data). Hooded Warblers construct their nests in a wide array of plant species (Chiver *et al.* 2011; BSC unpubl. data). Studies in southwestern Ontario found that Hooded Warbler nest sites have significantly more large mature trees (>38 cm diameter at breast height), fewer small trees, and higher canopy height (mean 27 m) compared to elsewhere in the forest patch (Gartshore 1988; Whittam *et al.* 2002; Eng 2007).

Habitat used by dependent young during the critical post-fledgling period is also quite specific and differs from that used at other life stages (Eng 2007; Rush and Stutchbury 2008). Fledglings being fed by their parents generally stay within the breeding territory but move into areas with dense shrubs and saplings in the 0-4 m understory layer (Eng 2007; Rush and Stutchbury 2008).

An analysis of range-wide occurrence data shows that a high proportion (80%) of the total Hooded Warbler population occurs in landscapes with contiguous forest cover (Donovan and Flather 2002). Due to its preference for large forest tracts and reported avoidance of forest edges, the Hooded Warbler has been characterized as an area-sensitive, forest-interior species (e.g., Robbins *et al.* 1989; Freemark and Collins 1992; Norris *et al.* 2000; Parker *et al.* 2005). These preferences are not absolute: Hooded Warblers will use forest edges and they can nest successfully in very small forest patches (e.g., <5 ha in Pennsylvania, as small as 10 ha in Ontario) in areas with high regional forest cover (Norris *et al.* 2000; Norris and Stutchbury 2001; Melles 2007; Chiver *et al.* 2011).

In Ontario, most (up to 95%) known occurrences are within large (>100 ha) forest patches; and forest patch size, regional forest cover (within 2 km) and forest connectivity are important predictors of whether a forest patch will be occupied (Pither 1997; Flaxman 2004; Melles 2007). A strong spatial correlation between Hooded Warbler occurrences in Ontario and areas with sand deposits and sandy soils was first noticed in the 1980s (Gartshore 1988). The ecological basis of this physiographic association, which is still evident in the current expanded breeding distribution, is not known (Page and Cadman 1994; Pither 1997).

Due to its predilection for early successional canopy gaps, this species consistently occurs at higher densities in mature forests that have been subject to selective logging within the past 2 to 20 years than in forests that have not been logged for at least 30 to 50 years (Annand and Thompson 1997; Robinson and Robinson 1999; Hetzel and Leberg 2006; Eng 2007). Breeding density increases have also been reported following insect outbreaks or severe weather events that created gaps in the forest canopy (Tingley *et al.* 2002; Brown *et al.* 2011). Nesting habitat typically becomes suitable a few years after formation of a canopy gap and can remain suitable for several years until the canopy gap closes in again, though there appears to be considerable variation in the timing of gap colonization and abandonment (Gartshore 1988; Robinson and Robinson 1999; Whittam *et al.* 2002; Hetzel and Leberg 2006; Chiver *et al.* 2011).

Breeding territories are often clustered, with more birds within 200 to 500 m of each other than expected if birds were randomly distributed across available habitat (Melles *et al.* 2009). Social factors (e.g., proximity to other birds) appear to influence both nest site selection and territory location within and among sites (Melles *et al.* 2009; Chiver *et al.* 2011).

The size of individual breeding territories varies between and within regions (Chiver *et al.* 2011). In Pennsylvania, typical territory size in a high density situation was 75 m x 75 m (mean=0.85 ha, range 0.4-2.5 ha, N=47), compared to territories exceeding 150 m x 150 m (2.25 ha) in low density situations (Howlett and Stutchbury 1997; Tarof *et al.* 1998). Territories in very small forest patches in Pennsylvania were the same size as the patch, 0.5-2.0 ha (Norris *et al.* 2000). Average territory size at sites in Ontario is generally larger than reported in Pennsylvania: e.g., 3.2 +/-2.7 ha, N=33, range 0.3 to 11.4 ha at the St. Williams Conservation Reserve (SWCR); and 1.1 to 2.4 ha (N=16) in smaller woodlots (<50 ha) situated within 20 km of SWCR (BSC unpubl. data, 2003-05; S. Melles, unpubl. data, 2004-05).

Wintering Habitat

The Hooded Warbler winters in humid to semi-humid lowland forest and scrub habitats (Chiver *et al.* 2011). There is strong sexual segregation by habitat, with males preferring closed canopy forests whereas females prefer open woodland, early successional forest, and scrub habitats (Lynch *et al.* 1985; Stutchbury 1994; Conway *et al.* 1995). Both sexes overlap in intermediate habitat types (Chiver *et al.* 2011).

Migration Habitat

During migration this species is found in wooded habitats, including edge and canopy gaps in mature forests in inland situations, and coastal woodlands and wooded islands along the Gulf Coast in southeastern United States (Langin *et al.* 2009; Chiver *et al.* 2011).

Habitat Trends

Breeding Habitat

Longer-term changes in the extent and distribution of woodlands in southern Ontario have been described by Larson *et al.* (1999), who examined various existing data sets covering the area south and east of the Canadian Shield (generally equivalent to the Carolinian and Lake Simcoe-Rideau ecological regions combined; Figure 1). Since 1700, the landscape of southern Ontario has undergone radical changes, from a predominantly forested landscape with small amounts of natural openings (prairie, savannah, alvar, open wetlands) and some areas of Aboriginal agriculture, to almost completely forested following the demise of the Aboriginal people upon contact with Europeans, to almost completely deforested by 1900 due to the wholesale removal of the forests by the early settlers (Larson *et al.* 1999).

Forest cover in southern Ontario reached a low of about 10% in 1920, but by 1986 had almost doubled to about 19% due to the regeneration of young forests in areas of marginal farmland (Larson *et al.* 1999). The most recent data (2002 Ontario Land Cover mapping) indicate a continued increase in overall forest cover in southern Ontario to 29% (OMNR 2006).

Within southern Ontario, most of the increase in forest cover has occurred in southeastern Ontario and elsewhere in the Lake Simcoe-Rideau region, which now has 35% forest cover (and 56% agriculture) (OMNR 2006). There has been little net change in forest cover in the Carolinian region, which at 15% overall (versus 72% agriculture) remains well below the 30% minimum threshold considered necessary to maintain forest bird diversity (OMNR 2000, 2006; Environment Canada 2004; Badzinski 2007; Crins *et al.* 2007). Within the Carolinian region, Hooded Warblers are generally associated with areas of higher forest cover, such as Norfolk County and Niagara Region (Badzinski 2007).

Efforts to model Hooded Warbler habitat in Ontario at a landscape scale using satellite imagery have had limited success because the coarse spatial and temporal resolution of the Landsat images are not well suited to identifying the specific fine-grained habitat requirements of this species (Pither 1997; Flaxman 2004; Pasher *et al.* 2007). Canopy gap habitat can be accurately identified using fine spatial resolution Ikonos imagery but this approach is cost-prohibitive at a larger scale (Pasher *et al.* 2007; Melles *et al.* 2009). Consequently, there are no good estimates of the amount and distribution of potential Hooded Warbler habitat in Ontario.

Quantitative information on trends in forest quality is not available, but most forest habitat within the current Ontario breeding range is relatively young; only about 12% of southern Ontario forest is classified as mature, and < 1% is considered old-growth (OMNR 2006). Reforestation efforts in the early- to mid-20th century to stabilize areas of erosion-prone sandy soils in southern Ontario have, however, resulted in tracts of pine plantations that have matured to a point where they now provide suitable breeding habitat for this species (Badzinski 2007). Forest configuration is a concern because of this species' sensitivity to forest fragmentation effects. Forests within the Carolinian region in particular are highly fragmented, with < 500 patches over 100 ha in size (Flaxman 2004). Forest health and diversity across southern Ontario is also compromised due to various native and exotic invasive plants, pests, and diseases (e.g., Scarr *et al.* 2011). At low levels, insect outbreaks and tree mortality can enhance Hooded Warbler habitat, but severe outbreaks, which alter forest structure (e.g., by killing a high proportion of the large canopy trees), are detrimental.

Wintering and Migration Habitat

As with other neotropical migrants, loss and degradation of wintering and migration stopover habitat is a concern. Wintering habitat in Mexico and Central America has been affected by deforestation and agricultural intensification (Conway *et al.* 1995; Chiver *et al.* 2011). Specific information on trends in non-breeding habitat is not available.

BIOLOGY

The Hooded Warbler has been the subject of numerous field studies across various parts of its breeding range, wintering range, and at migration stopover sites (Chiver *et al.* 2011). The breeding biology of the population in southern Ontario has been the focus of several studies at core sites, including longer-term work at two large (>1000 ha) public forest complexes with the largest known Hooded Warbler population in Canada: the South Walsingham Forest in 1988-98, and the St. Williams Forest (now St. Williams Conservation Reserve, SWCR) in 1999-2010 (both in Norfolk County). A small breeding population in the Ganaraska Forest (mostly in Durham Region) in south-central Ontario, 200 km northeast of Norfolk County, has been studied since it was first reported in 2006 (Walters and Nol 2011). This section of the report draws on information from the US range as summarized in the revised Birds of North America species account (Chiver *et al.* 2011), supplemented with additional information from the Canadian range.

Life Cycle and Reproduction

Breeding Season

Territorial males sing frequently throughout their lengthy breeding season, from when they arrive on territory (early May in Ontario) until they begin their post-breeding moult (late July through September in Ontario). Although males are detected more frequently than females on the breeding grounds, similar numbers are captured during migration and the adult sex ratio is presumed to be approximately equal (Eng 2007; Melles 2007).

Males and females both engage in extra-territorial forays to seek out extra-pair copulations with neighbours (Chiver *et al.* 2011). Males in very small isolated forest fragments will foray long distances (up to 2.5 km) across non-forest habitat (Norris and Stutchbury 2001). Females in small fragments do not travel far (<130 m) and therefore have limited mate choice relative to females in continuous forest (Norris and Stutchbury 2002).

The Hooded Warbler is socially monogamous with most breeding males having a single female on their territory. A few males are polygynous and have two females, and a variable proportion of territorial males remain unmated. Pairing rates at study sites in Ontario (e.g., 75%, range 60% to 90% at SWCR, BSC unpubl. data; and 76% to 83% in smaller woodlots near SWCR, Bisson and Stutchbury 1998; Eng 2007; Melles 2007) are lower than rates reported in areas of high forest cover (e.g., 94% paired males at a site in Pennsylvania, Chiver *et al.* 2011).

The paternity of Hooded Warbler nestlings has not been studied in Ontario. In Pennsylvania, extra-pair fertilizations are very common, involving up to 67% of all broods and 54% of all nestlings in a high density population in a large (>100 ha) forest, and 26% of broods and 22% of nestlings in low density situations in very small (<5 ha) forest patches (Stutchbury *et al.* 2005).

The breeding biology of this species is fairly typical of other small passerines. Data from southern Ontario are consistent with information summarized in Chiver *et al.* (2011). Both sexes typically start to breed at 1 year of age. Females construct distinctive cup-shaped nests typically in low shrubs, tree saplings or ferns. Clutch size is generally 3 or 4 eggs, range 1 to 5. Second clutches are typically smaller than first clutches. The incubation period is 12 days; incubation and brooding is by the female only and begins with the laying of the last egg. The altricial nestlings are fed by both adults and leave the nest 8 to 9 days after hatching. Once young are fledged, each parent assumes responsibility for feeding approximately half of the brood until young reach full independence at 4 to 6 weeks after fledging (Evans Ogden and Stutchbury 1997). The Hooded Warbler is frequently double-brooded and will re-nest up to three times if previous nests are unsuccessful (Evans Ogden and Stutchbury 1996; Howlett and Stutchbury 2003). At SWCR, each year about 20% of nesting pairs produce two successful broods and a few instances of females attempting a third brood have been reported (BSC unpubl. data).

Hooded Warbler nests are routinely parasitized by Brown-headed Cowbirds (*Molothrus ater*) with 5-75% of nests having one or more cowbird egg (Kilgo and Moorman 2003; Chiver *et al.* 2011). Brood parasitism rates in Ontario are intermediate. For example, at SWCR during 1999-2010, 35% of nests (N=497) were parasitized, with annual parasitism rates ranging from 13% to 52% (BSC unpubl. data). Other studies in southwestern Ontario reported similar rates (Bisson and Stutchbury 1998; Badzinski 2003; Melles 2007). At the Ganaraska Forest site in south-central Ontario, the first case of nest parasitism was not detected until 2010 (e.g., 0 of 12 nests in 2006-07) (Walters and Nol 2011). Eng (2007) found significantly higher parasitism at recently logged sites, and in small (<75 ha) patches. Parasitism rates are highest early in the breeding season and late nests are infrequently parasitized (Badzinski and Calvert in prep.). Parasitized nests fledge fewer host young than non-parasitized nests (Chiver *et al.* 2011). At SWCR, parasitized nests had smaller clutches (2.8 ±1.0, N=128 versus 3.6± 0.6, N=279), lower hatch rate (46% versus 72% of eggs hatched), and lower nestling survival (55% versus 81% of hatched young fledged) (BSC unpubl. data; Badzinski and Calvert in prep.).

Hooded Warblers experience relatively high nest predation rates (e.g., 25-44%) across their range (Sargent *et al.* 1997; Moorman *et al.* 2002; Lacki *et al.* 2004; Chiver *et al.* 2011). In Ontario, nest predation rates vary considerably from year to year but are generally high, 30-50% (Badzinski 2003; Eng 2007; Melles 2007; Chiver *et al.* 2011; BSC unpubl. data). Predation rates did not differ between recently logged and undisturbed reference stands, or by patch size in two Ontario studies (Eng 2007; Melles 2007). Predation is the primary cause of nest failure at sites in Ontario and elsewhere and has a much larger influence on overall productivity than does nest parasitism (Stutchbury 1997; Eng 2007; Chiver *et al.* 2011; Calvert and Badzinski in prep.).

Hooded Warblers breeding in southern Ontario and in fragmented landscapes in the US have low productivity relative to birds breeding in areas with continuous forest cover (Eng 2007; Badzinski and Calvert in prep.; Chiver *et al.* 2011). However, total seasonal productivity is influenced by whether the nest is parasitized and if the pair produces a second brood. At SWCR, single-brooded pairs that are parasitized have the lowest seasonal productivity (0.8 nestlings surviving to 5 days post-hatch), compared to double-brooded pairs that are not parasitized (5.2 day-5 nestlings) (Badzinski and Calvert in prep). These rates are comparable to other studies of Hooded Warblers in Ontario (e.g., Eng 2007).

Survival

Two studies at sites in Pennsylvania and Ontario found fledgling survival is low in the first few days after leaving the nest, with 19% and 49% of the tracked fledglings surviving to independence (Eng 2007; Rush and Stutchbury 2008; Chiver *et al.* 2011). Overwinter survival does not appear to vary by habitat (Conway *et al.* 1995). Mark-recapture estimates of local survivorship (birds that survive and return to the same breeding site) for SWCR are 9.8% (SE=1.6%) for young, and 48.0% (SE=2.9%) for adults (Calvert and Badzinski in prep.). Population models using SWCR data show that growth rate is most sensitive to local adult survivorship (Calvert and Badzinski in prep.). However, actual survival probabilities for immatures and adults are likely considerably higher than these estimates, because local survival estimates are confounded by emigration. Quantitative information on dispersal and emigration rates is not available, but is thought to be highly important to this species' population dynamics (see also Dispersal and Migration).

As with other small passerines, the expected life span is short, and the generation time (average age of breeding adults) is likely about 2-3 years. This estimate is consistent with observations in Ontario and Pennsylvania, with relatively few birds returning for more than 2 consecutive years and about half (23%-60+%) of the known age adults being second-year birds (Evans Ogden and Stutchbury 1996; Rush and Stutchbury 2008; BSC unpubl. data). A female Hooded Warbler banded at the SWCR site in Ontario in July 2000 was at least 11 years old when last re-sighted in July 2009 (BSC unpubl. data). This exceeds the published longevity record of a male banded in Louisiana that was at least 8 years, 1 month old when last recaptured (Lutmerding and Love 2009).

Non-breeding Season

On the wintering grounds, some individuals establish and maintain exclusive feeding territories throughout the winter period from September – March (Lynch *et al.* 1985; Stutchbury 1994; Conway *et al.* 1995). Individuals often return to the same overwintering territory in subsequent years (Chiver *et al.* 2011). Winter territory size varies with habitat but is typically small, e.g., 0.3 to 0.4 ha (Stutchbury 1994; Chiver *et al.* 2011). One study comparing birds wintering in mature versus early-successional forest habitats in Belize found no evidence of a large difference in overwinter survival (Conway *et al.* 1995).

Food

The Hooded Warbler feeds mostly on insects, small spiders and other arthropods in all seasons (Chiver *et al.* 2011). Food supply does not appear to be a limiting factor during the breeding season or during spring and fall migration (Nagy and Smith 1997; Buehler *et al.* 2002; Moorman *et al.* 2007).

Physiology and Adaptability

No information on physiology is available.

Hooded Warblers exhibit a moderate degree of habitat plasticity on the breeding and wintering grounds (see Habitat). High densities occur in forests that have been selectively logged within the past 5-15 years, provided that many large-trees have been retained (Whittam *et al.* 2002; Chiver *et al.* 2011). This gap-specialist species is dependent on ephemeral nesting sites and is adapted to colonizing new habitat created by natural windfall or tree removal.

Dispersal and Migration

Information on dispersal in this species is limited (Chiver *et al.* 2011). In spring and fall, individuals appear to wander widely and are reported annually in areas north (Massachusetts) and west (California and Arizona) of the regular breeding range (Chiver *et al.* 2011). There is some evidence that young birds may scout out breeding territories before undertaking their first migration (Chiver *et al.* 2011).

Hooded Warblers exhibit low fidelity to their natal sites, whereas adults frequently return to the same breeding site, and males in particular often return to the same territory (Howlett and Stutchbury 2003; Melles *et al.* 2009; Chiver *et al.* 2011). There is also evidence of high territory fidelity on the wintering grounds (Chiver *et al.* 2011).

At SWCR, there appears to be significant between-year immigration and emigration of both young birds and adult birds, including several instances of recruitment of birds banded as nestlings at other sites within 20 km and at least two instances of immigration of birds banded as breeding adults at sites 5-15 km away (BSC unpubl. data). Dispersal of many young and some adults over longer distances is considered likely but has not been documented (e.g., there are no banding encounters involving longer distance movements of birds captured or banded in Canada, Brewer *et al.* 2000). Moreover, a recent population model of SWCR population dynamics suggests that breeding numbers are maintained through frequent dispersal into and out of the population, a phenomenon that likely also occurs in other breeding areas (Calvert and Badzinski in prep.). Females appear to have higher dispersal rates than males (not related to breeding success) but more study is needed (Howlett and Stutchbury 2003; Chiver *et al.* 2011; Calvert and Badzinski in prep.).

Interspecific Interactions

See Life Cycle and Reproduction section for impact of Brown-headed Cowbird and predators on nesting success. Breeding habits and nest site selection are similar to some other forest-gap birds, particularly Chestnut-sided Warbler (*Setophaga pensylvanica*) and Indigo Bunting (*Passerina cyanea*), which are occasionally found nesting in close proximity to Hooded Warbler nests.

POPULATION SIZES AND TRENDS

Search Effort and Monitoring Programs

Incidental Observations

Much of what we know about the distribution and abundance of Hooded Warblers in Canada before the formation of the Hooded Warbler/Acadian Flycatcher Recovery Team (Recovery Team) in 1996 is the result of the efforts of amateur naturalists and birders who sought and documented observations of the Hooded Warbler because of its rarity. Historical records of the Hooded Warbler have been summarized by Baillie (1925), Gartshore (1988), Austen *et al.* (1994), and Bodsworth (2004). Volunteers and field biologists continue to report Hooded Warbler breeding occurrences to Bird Studies Canada (BSC) and the Ontario Natural Heritage Information Centre (NHIC). New occurrences away from the core breeding areas are often identified as a result of these incidental observations.

Ontario Breeding Bird Atlases

The Ontario Breeding Bird Atlases provide snapshots of the Canadian breeding distribution of Hooded Warblers for two periods: 1981-85 (OBBA1) and 2001-05 (OBBA2), respectively (Cadman *et al.* 1987, 2007). Most atlas squares (10 km x 10 km) within the Canadian breeding range of this species received a minimum of 20 hours of coverage, a level of effort considered adequate to detect the majority of species occurring in a square (Cadman *et al.* 2007). During the second atlas, 5-minute point counts were used to provide relative abundance information. In most squares within the breeding range of this species, at least 25 point counts were completed (mostly at predetermined roadside locations). During OBBA2, atlassers were asked to provide detailed location and abundance information for rare species such as the Hooded Warbler. Total field effort in southern Ontario increased moderately during OBBA2 and comparisons between atlases have been adjusted to correct for effort (Cadman *et al.* 2007). OBBA2 incorporated the results of a targeted Hooded Warbler survey carried out in 2002 (see below).

Directed Surveys

Subsequent to the completion of OBBA1 in 1985, there were a series of coordinated efforts to survey and monitor populations of rare breeding birds in Ontario (Austen *et al.* 1994; Deschamps and McCracken 1998). Starting in 1997, the Recovery Team initiated directed surveys to document the status, distribution and trends in the Hooded Warbler population in Canada (Friesen *et al.* 2000; Environment Canada 2011).

Extensive targeted searches of known and potential Hooded Warbler (and Acadian Flycatcher) breeding habitat in southern Ontario were carried out in 1997, 1998, 2002, and 2007 (Heagy *et al.* 1997; McCracken *et al.* 1998; Carson *et al.* 2003; Heagy and Badzinski 2008). In most instances, each site was visited once during June or July by an experienced surveyor who traversed areas of suitable habitat and counted the number of Hooded Warblers observed (mostly singing males). Although a similar strategy was used for each of these coordinated surveys, there were differences in the amount and distribution of survey effort. The 1997 and 1998 surveys covered 51 sites whereas the 2002 and 2007 surveys included 184 and 168 sites, respectively. Some of the 1997-98 survey sites consisted of large forest complexes with multiple landowners. In the 2002 and 2007 surveys, these "mega-sites" were each split into several smaller parcels and considered as multiple sites. The total number of person-hours of field effort increased with each round of surveys, from 350 field hours in 1997 to over 1600 person-hours in 2007 (Heagy and Badzinski 2008). However, the effort measures reported in later surveys included multiple visits to SWCR and some other sites as part of intensive nest monitoring projects. Survey effort at most other sites was similar in all surveys (Heagy and Badzinski 2008).

These directed surveys targeted known and historic locations but some areas of potential habitat were also covered. Due to ease of access and proximity to known sites, survey effort was concentrated in the extensive public forests in Norfolk County and public lands within the few large forest complexes elsewhere in the Carolinian region of southwestern Ontario. Search effort in forested areas north and east of the Carolinian region consisted of incidental reports from volunteers and researchers. Many forested areas on private land in southern Ontario have never been searched for this species.

Breeding Bird Survey

The North American Breeding Bird Survey (BBS) is a volunteer-based program designed to monitor trends in breeding bird populations (Sauer *et al.* 2011). BBS routes consist of 50 roadside points along randomly selected, stratified routes across the United States and southern Canada. Each point is surveyed once (3-minute point count) by an experienced birder during the breeding season. The number of individuals (excluding dependent young) of each species heard (at any distance) or seen (within a 400 m radius circle) during each stop is counted, with singing males being detected most frequently. The BBS has been run annually in the US since 1966 and in Canada since 1968. Not all routes have been surveyed continuously for the entire period.

As of 2010, the Hooded Warbler has been detected on 1056 BBS routes situated throughout its US breeding range but was reported from only two BBS routes in Ontario. The continental Hooded Warbler breeding population is considered adequately monitored by the BBS (Rich *et al.* 2004; Sauer *et al.* 2011). BBS data have been used to calculate population estimates and population trends at various geographic scales (Rich *et al.* 2004; PIF 2010; Sauer *et al.* 2011). The most recent BBS trend analysis (through 2009) uses a hierarchical model approach (Sauer *et al.* 2011).

Migration Counts

This species is detected regularly in small numbers on migration (particularly in spring) at birding hotspots and at banding stations in southern Ontario, including Point Pelee National Park and Long Point Bird Observatory (LPBO). Standardized migration count data from Canadian Migration Monitoring Network (CMMN) stations in southern Ontario provide a relatively unbiased measure of long- and short-term population trends in this species in Canada, as suggested by Gartshore (1988). A trend analysis of LPBO migration count data for Hooded Warbler for 1961-2010 was provided by Tara Crewe (BSC, pers. comm., October 2011). Annual indices and the population trend were estimated using a generalized additive model with Poisson distribution.

Winter

Wintering populations are not monitored.

Abundance

Within its small Canadian range, standardized surveys such as the BBS or OBBA2 point counts result in too few Hooded Warbler detections to provide reliable abundance estimates (Badzinski 2007). Previous population estimates (Table 2) are extrapolations based on the number of known occurrences (population counts), and subjective estimates of the amount of good or apparently suitable habitat within the presumed breeding range that has not been searched.

Badzinski (2007) provided a population estimate of 300 Hooded Warbler territories based on the OBBA2 data and some additional data from the 2006 breeding season. This estimate was eclipsed by the 2007 Hooded Warbler survey results, when at least 436 territorial male Hooded Warblers were detected at 89 sites (Heagy and Badzinski 2008). An updated population estimate of 1000 to 2000 mature individuals in 2011 is provided here.

The 2011 population estimate is based on the 2007 count data and assumes that the overall population has a balanced sex ratio with few non-territorial floaters such that the number of mature individuals is twice the number of breeding territories. The lower value of 1000 individuals is very conservative and assumes that the 2007 survey included >85% of the total population (i.e., detected all or most of the territorial birds at the sites that were covered, few or no birds were present elsewhere) and that the population has been stable since 2007. The upper value of 2000 individuals assumes that the 2007 survey detected only about 50% of the total population and that the population has increased 20% (~5%/yr) since 2007. Although subjective, these assumptions seem reasonable given the extent of known and suitable habitat not checked in 2007, and available population trend information for Ontario (see Fluctuations and Trends) and adjacent jurisdictions (see Rescue Effect).

It appears that the current population in Canada may already have achieved the population objective set in the proposed Recovery Strategy, specifically, of having 500 breeding pairs distributed within the species' current Ontario range (Environment Canada 2011).

The Canadian population constitutes less than 1% of the global Hooded Warbler population, which was estimated to be approximately 4,000,000 birds based on BBS data from the 1990s (Rich *et al.* 2004). Small changes in the large US Hooded Warbler population could have a significant ripple effect on the small Canadian population.

Fluctuations and Trends

Due to this species' dependence on early-successional nesting habitat, Hooded Warbler occupancy of large sites tends to shift and vary over time and can fluctuate moderately (e.g., 11-23 territories at South Walsingham Forest from 1985-2002 and 37-67 territories at SWCR from 1999-2010, BSC unpubl. data). Occupancy of small forest tracts may be ephemeral or intermittent. These local site-level fluctuations do not result in fluctuations in the overall population size over broader geographic regions.

Breeding Bird Atlas Results

There was a significant increase of >400% in the probability of observation for this species between atlases, with the number of 10 km x 10 km atlas squares with Hooded Warbler breeding evidence increasing from 21 during OBBA1 to 81 during OBBA2 (Badzinski 2007). Some of the observed increase for this species is attributed to increased survey efficiency and the special Hooded Warbler survey conducted during the OBBA2 period. Nonetheless, population estimates (Table 2) based largely on the BBA data suggest a significant increase in abundance over a 20-year interval (Sutherland and Gartshore 1987; Badzinski 2007).

Hooded Warbler Surveys

The results (by county/region) of the four extensive Hooded Warbler surveys carried out in Ontario between 1997 and 2007 are presented in Table 1, along with the 1988 population estimate by region as prepared by Gartshore (1988). Population counts have increased with each round of surveying since 1997. The count of 436 territories reported in 2007 is almost five times the 88+ known territories reported in 1997, just 10 years earlier. Population estimates based on these counts that take changes in survey effort and efficiency into consideration indicate the population increased >300% from 1997 to 2007 (Table 2).

Table 1. Hooded Warbler population counts and estimates for southern Ontario in 1988, 1997, 1998, 2002 and 2007 (data from Gartshore 1988; Heagy *et al.* 1997; McCracken *et al.* 1998; Heagy and Badzinski 2008). Counts include paired birds (counted as 1) and single birds. + indicates present but numbers not reported. – indicates no coverage of known sites in the county/region during this survey.

County/Region	1988 estimate	1997 count	1998 count	2002 count	2007 count
Brant	0	0	0	0	0
Chatham-Kent	1-2	0	0	0	1
Durham	0	0	0	5	21
Elgin	17-50	9	8+	9	8
Essex	0	0	0	0	0
Halton	1-2	-	-	2	8
Haldimand	-	0	0	0	-
Hamilton	1-2	-	0	17	16
Lambton	4-5	17	12-17	9	5
Middlesex	4-10	3	4-5	20	23
Niagara	0	+	8	23	40
Norfolk	50-100	59	62	147	301
Oxford	2-4	+	0	0	6
Peel	0	0	0	2	-
Simcoe	0	0	0	1	-
Waterloo	0-1	-	1	4	2
York	0	0	0	3	5
Total	80-176	88+	95-101	242	436
Number of Regions	8-9	5	6	12	12

Table 2. Population counts and estimates for the Hooded Warbler in Canada.

Source	Population Count	Population Estimate	Information Used
Sutherland and Gartshore 1987	21 squares with breeding evidence during OBBA1 include 3 squares with 2-10 pairs, 9 squares with single pair, and 9 squares with no abundance estimate [=25-53 pairs, Page and Cadman 1994]; 36 known pairs in 1986 (partial count)	may well approach 100 pairs	OBBA1 data plus 1986 records
Gartshore 1988	41 confirmed records between 1985-88 [plus additional unconfirmed records]	80 to 176 pairs in 1998	All available information including historic records, OBBA1 data, and additional 1986-88 data
Heagy *et al.* 1997	located at least 88 territorial birds	145 to 300 territories	1997 Hooded Warbler survey
McCracken *et al.* 1998	95-98 territorial birds	144 to 207 territories	1998 Hooded Warbler survey
Carson *et al.* 2002	242 territorial birds at 77 sites	n/a	
Badzinski 2007	81 squares with breeding evidence including 130 territories in Norfolk County and 33 territories in Niagara Region	300 territories	OBBA2 data and additional 2006 data
Heagy and Badzinski 2008	436 territorial birds at 89 sites	n/a	2007 Hooded Warbler survey
Heagy and Badzinski 2011 (for this report)	n/a	500 to 1000 territories in 2010 (1000 to 2000 individuals)	2007 Hooded Warbler survey and recent trends

Changes in abundance vary regionally and are generally consistent with the pattern of distribution change depicted in the atlas mapping (Figure 2). The Hooded Warbler population in Canada continues to be concentrated in Norfolk County, where survey counts have at least doubled every 5 years. Counts have also increased in areas east and northeast of Norfolk, particularly in Niagara and Hamilton Regions, but have not increased in other parts of southwestern Ontario, where numbers remain generally low. The small isolated population at Awenda Provincial Park near Midland, Simcoe County has persisted at low levels for more than 20 years (M. Wiercinski pers. comm., 2010). In the past decade, Hooded Warblers have expanded in the Greater Toronto Area, particularly in Durham Region and Northumberland County east of Toronto. To date there has been no evidence of Hooded Warblers nesting in the vicinity of Kingston or Prince Edward County in southeastern Ontario (T. Sprague pers. comm., 2011). The continued absence of breeding Hooded Warblers in the Kingston area is surprising given the proximity of breeding populations in New York, an increase in forest cover, and the species' status as a regular rare spring migrant there for more than 30 years (Austen *et al.* 1994; Weir 2008).

Migration Counts

Standardized counts of spring migrants at LPBO show a long-term increasing trend of 3.4%/yr ($p<0.0001$) over a fifty-year period 1961-2010, 2.7%/yr ($p=0.006$) over a forty-year period,1970-2010, and 6.2%/yr ($p=0.28$) for the most recent 10-year or approximately 3-generation period 2000-2010 (

Figure 3) (T. Crewe, Bird Studies Canada, pers. comm., October 2011). Although not statistically significant, the 10-year trend is equivalent to an 80% increase.

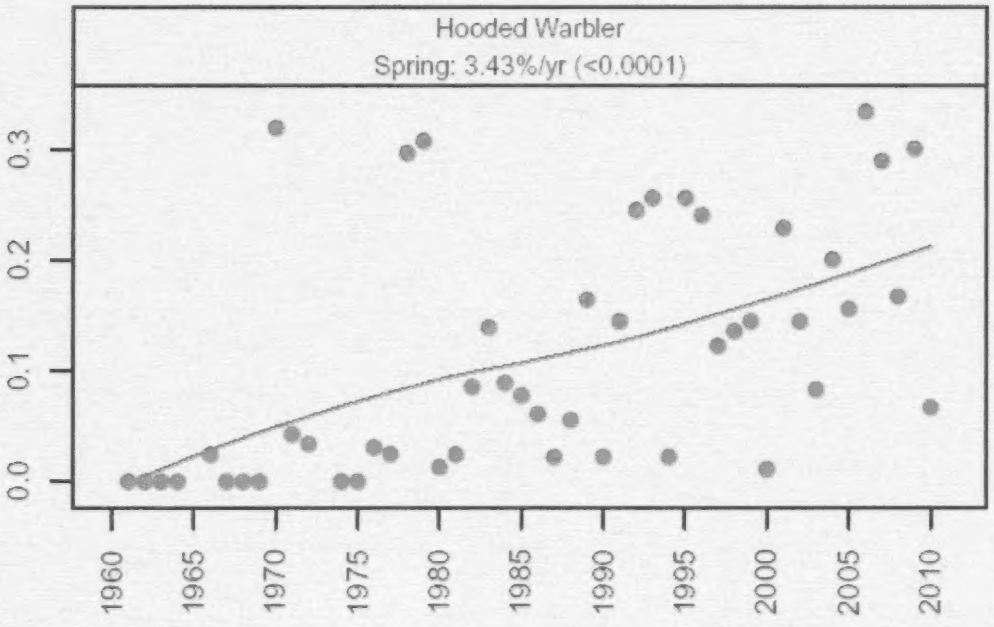

Figure 3. Hooded Warbler spring migration count indices 1961-2010 and trend at Long Point Bird Observatory, Norfolk County, Ontario (courtesy of Tara Crewe, Bird Studies Canada).

Summary

Data from all sources show a consistent pattern of strong increases in the abundance and distribution of the known Hooded Warbler population in Canada. Population counts for this species are confounded by increases in search effort and efficiency over time but the population has at least doubled over the past decade. There is no reason to expect that the population will not continue to grow and expand, at least over the next ten years.

Rescue Effect

There is a high probability of regular immigration of birds into Canada from the US population given the pattern of northward range expansion (see Distribution), the species' biology (see Dispersal and Migration), and proximity to large, rapidly increasing populations in adjacent US states. Hooded Warbler population estimates for Pennsylvania and Ohio (based on 1990s BBS data) are 140,000 and 80,000 individuals, respectively (PIF 2010). BBS population trends for Pennsylvania and Ohio, respectively, are 3.9 and 6.1%/yr for 1966-2009, and 4.4 and 6.4%/yr for 1999-2009 and are statistically significant (Sauer *et al.* 2011). The range-wide BBS data also show statistically significant increases of 40% (3.4%/yr) for 1999-2009 and over 100% (1.8%/yr) for 1966-2009 (

Figure 4).

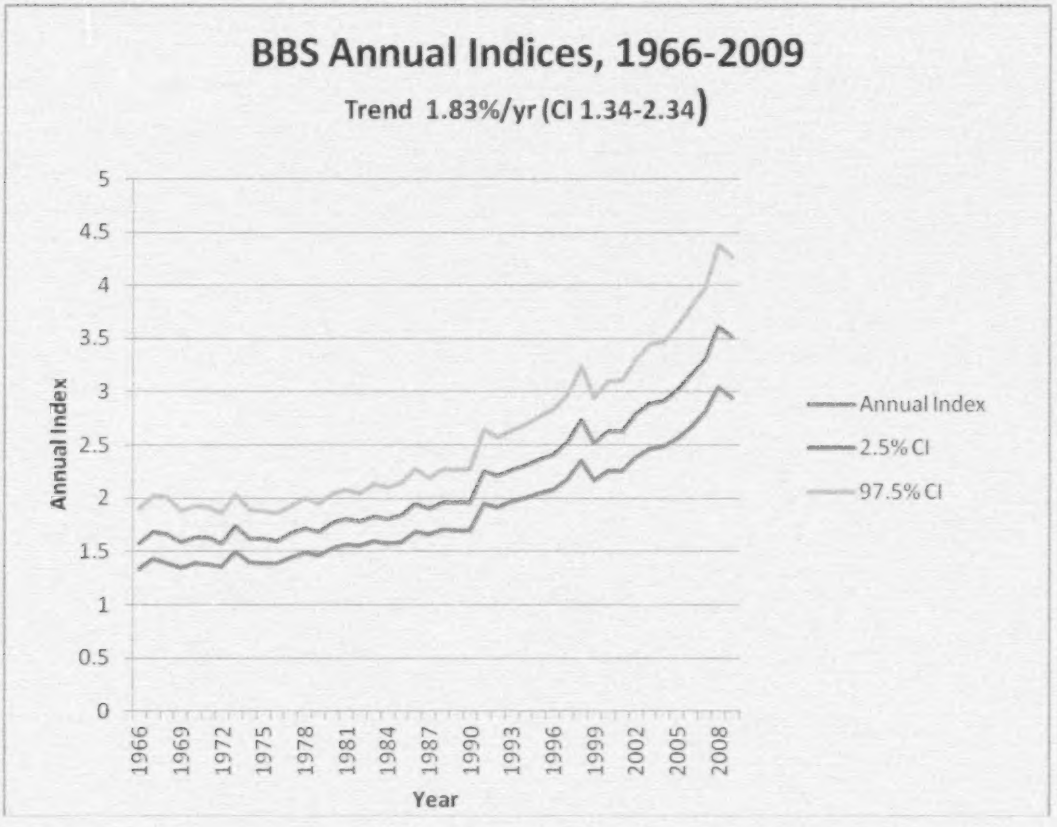

Figure 4. Annual indices of range-wide abundance from the North American Breeding Bird Survey for Hooded Warbler from 1996-2009 (Sauer *et al.* 2011).

THREATS AND LIMITING FACTORS

Habitat

There is little evidence to support the view that the availability of appropriate breeding habitat in southwestern Ontario is the primary factor limiting Hooded Warbler population growth in Canada, as proposed in previous reports (Page and Cadman 1994; James 2000; Friesen *et al.* 2000). Overall forest cover in southern Ontario has increased from historic lows and this species has recently expanded north and east into parts of southern Ontario with greater forest cover (see Habitat Trends, and Canadian Range). Available habitat in southern Ontario does not appear to be saturated, even at core sites such as SWCR, which have been occupied for more than a decade (Melles *et al.* 2009).

Habitat degradation has also been identified as a concern as this species requires mature forest and is adversely affected by forest fragmentation (see Breeding Habitat Requirements, and Life Cycle and Reproduction). Specific threats identified in the Recovery Strategy include intensive logging that removes all or most mature trees (i.e. diameter-limit cuts), insect and disease outbreaks that eliminate a large number of mature trees, direct and indirect habitat damage caused by recreational vehicles, and housing estates and other development activities in or adjacent to woodlands (Environment Canada 2011). Conversely, some studies have found that selective logging, insect outbreaks, and severe weather events that open the forest canopy can increase local Hooded Warbler breeding densities (see Breeding Habitat requirements).

Loss and degradation of habitat at migration stopover sites and on the wintering grounds are also identified as potential threats but the magnitude of these threats is not known (Chiver *et al.* 2011; Environment Canada 2011; NatureServe 2011).

Source-sink Population Dynamics

Various demographic studies in Ontario (and also in northwestern Pennsylvania) found evidence of depressed productivity and survival, leading to the suggestion that Hooded Warbler populations in fragmented landscapes at the northern range periphery may be population sinks, where local productivity is not sufficient to offset adult mortality/dispersal (Eng 2007; Rush and Stutchbury 2008; Chiver *et al.* 2011). Since breeding numbers at these study sites are generally stable or increasing, local populations appear to be sustained through regular immigration of young and adults from elsewhere. Available population models are limited by the lack of information on the scope and scale of dispersal movements, especially the lack of quantitative measures of adult emigration rates (see Dispersal and Migration). As with other species dependent on early successional habitats, dispersal is considered to be an important factor in Hooded Warbler population dynamics (Calvert and Badzinski in prep.)

It is highly unlikely that local productivity alone can account for the strong population increase and range expansion in Ontario. Presumably birds are dispersing from some undetermined source population in the core US breeding range, where high densities of Hooded Warblers are present in regions with extensive continuous forest cover (see Rescue Effect). Long-distance dispersal patterns have been described in the Cerulean Warbler, another forest-obligate wood-warbler species with a similar breeding distribution, although in that declining species the pattern was reversed with birds on the breeding range periphery tending to disperse into the core region (Girvan *et al.* 2007). If source-sink population dynamics are occurring at the continental scale, then small changes in the productivity of source populations in the US could have large impacts on the trajectory of the small Canadian population (Environment Canada 2011).

Factors Driving the Population Increase and Range Expansion

Multiple factors may be contributing to the significant increase in the size and range of the Hooded Warbler population in Canada and continentally including climate change and reforestation in eastern North America. The observed pattern of northward range expansion of the Hooded Warbler (and other "southern" landbird species), as depicted by BBS and BBA data from recent decades, is generally consistent with the pattern of change in various climatic variables associated with climate warming (Matthews *et al.* 2004; Schwartz *et al.* 2006; Hitch and Leberg 2007; Rodenhouse *et al.* 2008; Zuckerberg *et al.* 2009; Melles *et al.* 2011). For example, Melles (2007, 2011) found that the cooler temperatures were positively related to a lack of range expansion and that the number of extreme weather days in July was an important predictor of Hooded Warbler presence in Ontario. However, the ecological mechanisms underlying the correlations identified in these empirical studies are not understood. Increased forest cover and the associated increased availability of suitable mature forest habitat in southern Ontario and the northeastern United States over the past century has also been beneficial to this species (Badzinski 2007).

Summary

There are many environmental factors operating in concert at various scales that influence the status of the Hooded Warbler in Canada including habitat conditions (e.g., quality, quantity, and connectivity), biotic processes (e.g., productivity, survivorship and dispersal, social behaviour), and climate conditions (e.g., heat units, temperature extremes, precipitation, etc.).

PROTECTION, STATUS, AND RANKS

Legal Protection and Status

The Hooded Warbler is protected in Canada under the *Migratory Birds Convention Act* (MBCA 1994). This legislation prohibits the possession or sale of migratory birds and their nests, and activities that are harmful to migratory birds, their eggs, or their nests, except as permitted under the *Migratory Bird Regulations*. This species also received legal protection in the United States and Mexico under similar legislation.

The Hooded Warbler was assessed by COSEWIC in 1993 and again in 2000 and then listed as Threatened under Schedule 1 of the federal *Species at Risk Act* when the Act came into force in 2003. SARA prohibits harming or possessing a listed species, or damaging its residence or critical habitat.

The Hooded Warbler was formerly listed as Threatened in Ontario and is currently listed as a Special Concern species under Ontario's *Endangered Species Act, 2007* (ESA) (OMNR 2010).

Non-Legal Status and Ranks

This species is ranked as Least Concern on the IUCN Red List by BirdLife International (BLI) and as globally secure (G5; last reviewed 1996) by NatureServe (BLI 2009; NatureServe 2011). The Canadian General Status designation ranks for this species are At Risk (1) in Canada and Ontario, and Accidental (8) in all other jurisdictions except Prince Edward Island, Yukon and Northwest Territories, where it has not been reported (CESCC 2006).

In Canada and Ontario, the Hooded Warbler is currently ranked as N3B (vulnerable breeding species) and S3B (vulnerable), respectively (NatureServe 2011; NHIC 2011). These ranks are being revised to N4B and S4B (Apparently Secure) to reflect current abundance and distribution and increasing population trend (D.A. Sutherland, pers. comm., 2011). In the United States, the species is nationally secure (N5B) and is ranked as secure (S5) or apparently secure (S) in most jurisdictions. In states bordering its Canadian range, the Hooded Warbler is ranked as secure (S5) in New York and Ohio, apparently secure (S4) in Pennsylvania, vulnerable (S3) in Michigan and Minnesota, and imperiled to vulnerable (S2S3) in Wisconsin (NatureServe 2011).

The Hooded Warbler is identified as one of 195 species of Continental Importance in the North American Landbird Conservation Plan because 98% of its global population breeds within the Eastern Avifaunal Biome, and that avifaunal region has a very high stewardship responsibility for the conservation of this species (Rich *et al.* 2004). Due to its Threatened status, the Hooded Warbler was identified as a Priority Species in the landbird conservation plan for southern Ontario (OPIF 2008).

Habitat Protection and Ownership

The proposed federal Recovery Strategy identifies 56 sites with an estimated total area of 9055 ha as critical habitat for this species (Environment Canada 2011). None of the proposed sites with critical habitat are on federal lands (Environment Canada 2011).

In Ontario, the *Endangered Species Act, 2007* does not provide habitat protection for this Special Concern species, although its habitat is eligible as significant wildlife habitat. The *Ontario Planning Act* and the *Provincial Policy Statement* (PPS) provide protection to forests in southern Ontario, including providing protection for designated significant wildlife habitat and significant woodlands, and enabling municipal tree-cutting bylaws (PA 1990; OMMAH 2005). Planning decisions requiring municipal approval must be consistent with the PPS. Several municipalities have designated significant wildlife habitat and significant woodlands in their Official Plans. All upper-tier municipalities within the Hooded Warbler breeding range in Ontario have tree-cutting bylaws except for Essex and Chatham-Kent (OWA 2010).

Over half of the known Hooded Warbler sites in Ontario are on publicly owned lands, particularly working forests owned by local conservation authorities or municipalities. The large SWCR site is on provincial Crown land that has recently been regulated as a Conservation Reserve under the *Provincial Parks Act*. Land ownership and habitat protection statistics for the known population overestimate the overall level of protection of the population because survey effort has focused on protected areas and public lands. Most public and private sites are working forests that are being actively managed for timber and fuelwood production, as well as being used for recreation (off-road motorized vehicles, hunting, hiking, etc., BSC unpubl. data).

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COLLECTIONS EXAMINED

No collections were examined.